Conservation of Energy

6-5 The student will demonstrate an understanding of the law of conservation of energy and the properties of energy and work. (Physical Science)

6.5.3 **Explain how magnetism and electricity are interrelated by using descriptions, models, and diagrams of electromagnets, generators, and simple electrical motors.**
Taxonomy level: 2.7-B Understand Conceptual Knowledge

Previous/Future knowledge: In 4th grade (4-5.9), students summarized the properties of magnets and electromagnets (including polarity, attraction/repulsion, and strength). Students have not been introduced the concept of generators and simple electrical motors in previous grade levels. Students will further develop the concepts of electromagnets, generators, and simple electrical motors in high school physical science (PS-6-11).

It is essential for students to know that *magnetism* is the force of attraction or repulsion of magnetic materials.

- Surrounding a magnet is a *magnetic field* that applies a force, a push or pull, without actually touching an object.
- An electric current flowing through a wire wrapped around an iron core forms a *magnet*.
- A coil of wire spinning around a magnet or a magnet spinning around a coil of wire can form an *electric current*.

Examples of how magnetism and electricity are interrelated can be demonstrated by the following devices:

Electromagnets

- An *electromagnet* is formed when a wire in an electric circuit is wrapped around an iron core producing a magnetic field.
- The magnet that results loses its *magnetism* if the electric current stops flowing.

Generators

- A *generator* produces an electric current when a coil of wire wrapped around an iron core is rotated near a magnet.
- Generators at power plants produce electric energy for our homes.
- A generator contains coils of wire that are stationary, and rotating magnets are rotated by turbines. Turbines are huge wheels that rotate when pushed by water, wind, or steam.
- Thus mechanical energy is changed to electrical energy by a generator. Smaller generators may be powered by gasoline.

Simple electric motors

- An electric motor changes electrical energy to mechanical energy.

- It contains an electromagnet that rotates between the poles of a magnet.
- The coil of the electromagnet is connected to a battery or other source of electric current.
- When an electric current flows through the wire in the electromagnet, a magnetic field is produced in the coil.
- Like poles of the magnets repel and unlike poles of the magnets attract.
- This causes the coil to rotate and thus changes electrical energy to mechanical energy.
- This rotating coil of wire can be attached to a shaft and a blade in an electric fan.

It is not essential for students to know components of generators or motors, the difference between AC and DC generators, or the function of a transformer. Understanding of how a magnetic field is produced is also not essential.

Assessment Guidelines:
The objective of this indicator is to *explain* how electricity and magnetism are interrelated by using descriptions, models and diagrams of electromagnets, generators, and simple electrical motors; therefore, the primary focus of assessment should be to construct a cause-and-effect model of how electricity and magnetism are interrelated. However, appropriate assessments should also require students to *interpret* diagrams of electromagnets, generators, or electric motors showing how electricity and magnetism are interrelated; *summarize* information about how electricity and magnetism are interrelated using diagrams, models, and descriptions of devices; *compare* devices based on how they interrelate electricity and magnetism; or *recognize* devices based on their functions.